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Image Assessment System and Landsat Level 1 Product Generation System

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Project Report

Image Assessment System and Landsat Level 1 Product Generation System Consolidation Project

Location: EROS Data Center, Landsat 7 Program

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Abstract

The Mission Operations Center (MOC) at the Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, SD manages the Landsat 7 Image Assessment System (IAS) and Level 1 Processing System (LPGS). Both systems process Level 0 non-radiometric corrected Landsat 7 data into Level 1 radiometric and geometric corrected products. Production of products from Level 0 to Level1 is the primary function of the LPGS. The IAS performs image assessment and quality assurance on selected data stored in the Landsat 7 data archive.

Before launch of the Landsat 7 satellite in 1999, Computer Science Corporation built the IAS and LPGS as two independent systems. Recently, the Landsat 7 Mission Management Office (MMO) program management chartered a project to consolidate parts of each system in an effort to lower overall maintenance and improve efficiency. In November 2001, MMO program management signed a formal project plan. The project plan identifies the Level 1 team and outlines the initial scope and deliverables of the consolidation.

The consolidation consists of business process analysis, database analysis, hardware consolidation, and a significant amount of software changes. The hardware consolidation activity involves an analysis of the existing hardware followed by combining two systems into one. Savings of $26,000 the first year and $19,000 thereafter are realized from this activity.

Organizing the software to utilize the same archive and share common libraries between the systems is one activity in the software development area. The primary goal is to produce an easily maintained single delivered system, Level 1, with two subsystems, IAS and LPGS. The IAS system utilizes Developer 6.0 for its Graphical User Interface (GUI). Developer 6.0 has been de-supported for the IRIX platform. The LPGS system uses Trolltech QT development tool for its interface. The other major software activity is to convert all Oracle Developer forms to QT.

Each potential change to the system is driven by systems engineering processes approved by the Landsat 7 program. Changes are requested through a Configuration Change Request (CCR). The request is used to track the changes throughout the life cycle. Specific deliverables are due for each CCR as it progresses through each stage of development. A number of CCR's may make up a release. Not all CCR's require software changes. Several levels of testing are completed on each release to insure that it meets requirements.

The program has already seen financial and administrative benefits from the project. These include maintenance cost savings, less overall database and system administration support, faster release management and improved software integration. This project provides a significant impact to the overall success of the Landsat 7 program.

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I. Introduction

Computer Sciences Corporation developed the Landsat 7 Image Assessment System (IAS) and the Landsat 7 Level 1 Product Generation System (LPGS) at Goddard Space Flight Center. Shortly after launch of the Landsat 7 satellite in 1999, the management of the program was moved to the EROS Data Center. The Landsat 7 program Mission Management Office (MMO) at the EROS Data Center is currently maintaining the systems. The MMO started an initiative to combine certain aspects of the two systems. Two major goals of the consolidation include a single system delivery and major cost savings. In November 2001, MMO Management signed the IAS/LPGS Consolidation Project Plan[i] to formally start initiatives to consolidate the systems.

The LPGS and IAS systems are managed by the Landsat MMO through the Data Handling Facility Configuration Control Board (DCCB) with the use of Configuration Change Requests (CCR's). Any changes to existing systems shall be facilitated through the use of CCR's, being assigned to specific releases. Approximately every quarter a release for a system takes place depending on the priority of the CCR's and the decision of the DCCB.

Since the consolidation project hasn't been a priority compared to many bug fixes or other enhancements, the CCR's for the consolidation project become a lower priority and assigned to later releases. This may cause the consolidation project schedule to fluctuate considerably.

This document serves as the project report for the IAS/LPGS consolidation project. It describes the overall problem being addressed, objectives, deliverables, scope, action items, schedule, implementation methods, and an outline of the project work. Appendixes are provided as the documentation completed as the project is worked. Most of the appendices documents are formal deliverables for Landsat MMO and have been peer reviewed by Landsat Level 1 team members and formally approved by the DCCB.

II. Statement of the Problem

Prior to an organizational change within the Landsat 7 program in 2001, independent development teams maintained the IAS and LPGS systems. Although the two systems contain modules that use the same code, independent archives and developers maintain each system. Each has its own archive located on its independent development system. As code changes are made on one, they are copied into the other archive; thus, leaving room for manual error.

The IAS and LPGS systems have many similarities:

- Redundant Global Software Library Routines
- Redundant Database Calls and Tables
- Radiometric Calibration Data on LPGS and IAS
- Radiometric Processing System (RPS) and Geometric Processing System (GPS) Design

Hardware for the systems is managed independently. The IAS and LPGS systems utilize separate development and production hardware. Combining hardware will reduce maintenance costs and provide enhanced efficiency for the program.

Reducing overall maintenance and labor costs is the primary driver of this project. In order to reduce overall costs, the project will investigate combining software, database, and hardware resources to create a single system with two subsystems, IAS and LPGS.

IAS and LPGS Software Consolidation

Two main areas of the software subsystems will be addressed: The software library and the IAS GUI.

IAS and LPGS Software Library Consolidation

The IAS and LPGS system are currently delivered independently. The global libraries for IAS and LPGS are shared, but maintained as independent entities. Software releases are difficult since LPGS must copy the IAS global libraries into their source tree for each release. This is inefficient and costly for the Program.

Software consolidation will ensure that all shared software between the systems is built, tested and released as one unit. This ensures that the modules are identical between the systems. It also ensures the system gains a combined thorough test plan and test resources.

IAS GUI Transformation

The IAS Operator Graphical User Interfaces (GUI's) are currently executed using Oracle Developer on the SGI IRIX platform. Oracle has de-supported future bug fixes for Oracle Developer on the SGI platform. Oracle Developer will continue to support its main platforms such as SUN and Windows NT. Changing the GUI's has the advantage of reducing the Program's IRIX/Oracle dependency. This task includes "reengineering"

the GUI's, deploying architecture other than Oracle Developer on the SGI platform. This new architecture should migrate easily to other platforms such as LINUX and/or Windows NT. This task may also include redesigning the GUI's to change business processes and/or "look and feel".

The LPGS system has redesigned its interface using TrollTech's QT C++ interface. QT is becoming a standard within the Landsat Program. Developers are familiar with C++. Use of the utility is free if the product being developed is not used for commercial use or resold. MMO management recommends the use of QT for the IAS GUI's since it is already used for LPGS and other systems throughout the Program. QT is portable to other platforms if future migrations are necessary.

This will reduce costs in the long term based on reduction of the dependency of commercial software. Reducing the Program's dependency on Oracle Developer programmers may also reduce cost since Oracle developers have been difficult for the Program to retain.

Database Redesign and Consolidation

This area contains two parts:

1) IAS Database Partitioning

The IAS database is nearly 70 GB in size. Most of the data resides in four trending tables and indexes. Management of this database is complex. Rebuilding indexes of these tables can take days. IAS must partition the database to segment the radiometry data across multiple Oracle tablespaces and disk subsystems. Partitioning will also

make it possible to make the old data read-only; thus saving on backup storage and time.

Without partitioning, the costs of administration will continue to grow. Eventually, management of the data will be unpractical.

2) Combining IAS and LPGS databases

IAS and LPGS databases each have an Oracle instance. Each database uses its own shared memory area. The databases have many similarities. It may make sense to combine all or part of these into one Oracle instance. LPGS could write its radiometry data directly to the IAS tables rather than using the nightly transfers. A database analysis and feasibility study must be completed for this activity.

Hardware Consolidation

The IAS and LPGS systems each have their own hardware for development and production purposes. By combining the software libraries, it may be more efficient for developers to work on one development platform while saving expensive hardware maintenance costs for the Program.

LPGS01 (development) and LPGS02 (production) account for $60,856 in maintenance costs per year. The IAS001 (development) and IAS002 (production) systems account for $17,864 in maintenance costs per year. These numbers exclude disk subsystems and external peripherals.

Engineers must analyze the performance requirements of the combined IAS and LPGS system to determine what hardware will be necessary. A cost/benefit analysis should be prepared for system consolidation and/or system replacement.

Operational Business Processes

Level 1 Operators may become more involved in several IAS operations functions, including search and ordering as well as public relations (PR) product processing. Business processes for these areas will need to be developed. This area may be combined with the GUI redesign identified above.

III. Objectives and Product Deliverables

The Statement of Problem section outlines what parts of the system need addressing. This section outlines what needs to be done in each area. Technical work may not be necessary for all areas defined. Only a short analysis may be necessary.

Project Scope

Any items not listed under the Objectives and Product deliverables section is considered out of scope for this project.

Software Library Consolidation

IAS and LPGS use many of the same modules and libraries, but the systems are delivered independently. Their shared software modules are managed by independent source code management systems. This task includes bringing these dependent modules together, making IAS and LPGS one deliverable. The modules will be part of a single source code

management repository. The IAS and LPGS system will be delivered as one system with two sub-systems, IAS and LPGS.

The source code repository and build files will be created in cooperation with the configuration management (CM) group. Software engineering will first perform initial analysis, requirements, and detailed software designs to identify exactly which modules need modifications. Software engineering will perform required development and integration so the repository and makefiles are turned over to configuration management before systems testing acceptance.

The software analysis will identify what modules and libraries should be consolidated for this activity. Upon completion of the analysis, work will be assigned to the appropriate areas.

IAS GUI Transformation

Fortunately, LPGS has already performed trade studies on different GUI's; IAS will inherit the design of the Qt GUI middle-layer libraries. This will move IAS away from Oracle Developer GUI's. The Qt-based GUI is portable to multiple platforms including SGI IRIX, Windows NT, Linux, and Sun Solaris. These libraries will be consolidated as part of the Software Consolidation effort. Each GUI must be re-constructed using the Qt GUI library set.

Additionally, certain business processes may be reengineered, requiring the creation of new GUI's and elimination of some of the existing GUI's. Requirements and Detailed Design Specifications must be created to support these processes.

Database Redesign and Consolidation

A. IAS Database Partitioning

Partitioning the database will only include tables with more than 10,000 rows of radiometry data. This includes tables in the RAD_TREND_DATA tablespace. Indexes for the radiometry data are included in the RAD_TREND_INDEX tablespace. Currently, the two tablespaces make up over 90% of the IAS database data. Partitioning this data will have a very large impact on increasing performance and decreasing administration costs.

This project does not include partitioning the database at the Landsat Science Office at the Goddard Space Flight Center.

B. Combining IAS and LPGS databases

A database analysis and design must be completed to determine the similarities between the two databases. This report may result in combining certain table data into one database. A recommendation needs to be written upon completion of the analysis. This must specifically address the database storage of the LPGS and IAS trending data.

Hardware Consolidation

Hardware consolidation includes a study to consolidate LPGS and IAS hardware only, specifically the IAS001 (development), IAS002 (production), LPGS01 (development) and LPGS02 (production) systems. This does not include PDS or other machines outside the IAS and LPGS scope.

Putting the development of the consolidated software on one system will increase the efficiency of developers. A study needs to be completed to determine if this is possible.

The University of Maryland has ported LPGS to the Intel LINUX platform. The Intel Itanium processors are the fastest single processors available on the market today according to the CPU2000 ratings from www.spec.org. It may be worth performing a trade study of the available architectures with the potential for a long term cost savings. This study will determine the worthiness of further investigation of alternative architectures for the IAS and/or LPGS system. This will be addressed further in the Future Considerations section of this document.

Operational Business Processes

Business processes for operating and managing both IAS and LPGS should be analyzed. Specifically, the IAS analyst order process could be shifted to LPGS operations. This may result in a need for additional software to support these processes.

IAS Automated Delivery

Currently, the IAS analysts receive emails of the available scenes that ECS has archived for the previous day. The analysts track these scenes in an Excel spreadsheet and order

specific scenes from Earth Observing System Data and Information System (EOSDIS) Core System (ECS). The analysts order about 10 scenes per day from this list. Some of the ordered scenes are the same each day, for example, the first and last scene of every subinterval. This process may be automated.

IAS analysts order Partial Aperture Calibrator (PAC) scenes using a method of manually determining the solar elevation angle. Manually measuring the reflection on the browse image determines the solar elevation angle. If the recalculation falls within a specific coordinate, the scene is ordered.

IAS analysts recommend linking an automated delivery system to the ECS ingest catalog located within the Mission Operations Database (MDS). From these records orders can be automated and tracked efficiently.

Public Relations Imagery

The IAS analysts frequently discover data that is ordered by other EDC departments to be used for public relationships purposes. Analysts also order this data for the specific department manager for public relations purposes. These processes should be analyzed.

IV. Project Goals

To: Combine the IAS and LPGS systems

In a way that:

- Cuts cost of maintenance of the hardware and software for the system
- Reduces hardware resources necessary for IAS and LPGS

- Utilizes efficient business processes with the operations and image assessment analyst staff
- Landsat 7 IAS and LPGS software resources work together as one unit

So that:

- Landsat 7 can improve the efficiency of its resources
- IAS and LPGS provide continued quality of service
- Landsat 7 IAS and LPGS staff work more effectively
- Landsat 7 database administration can more effectively manage the systems

V. Work Process and Release Management

While this project was in progress, the Data Handling Facility Configuration Control Board (DCCB) discontinued the Landsat Problem Reports (LPR's). Only Configuration Change Requests (CCRs) are necessary to manage change. Until January 2002, the DCCB process required all work to use an LPR. A System Prescreening Panel (SPP) reviews the LPR. If the LPR requires approval of the DCCB, it will be exported and imported into a CCR. The new process, approved by the DCCB in January 2002, eliminates the use of the LPR. Change requests are entered directly into the CCR and taken to the DCCB if approved by the SPP. Appendix A lists the old DCCB Configuration Change Process. Appendix B lists the current DCCB Configuration Change Process.

Below is a list of CCR's and LPR's with corresponding target releases associated with this project. Note: LPR's and CCR's may not require a target release.

LPR	CCR		Release (if applicable)
1915	1698	IAS - Qt GUI Conversions	IAS 6.0
1923	1729	IAS/LPGS Software Consolidation	IAS 6.0, LPGS 6.0
1927	NA	IAS/LPGS Development Hardware Consolidation	Release Independent
1940	1715	IAS Database Partitioning	Release Independent

Table 1 – Configuration Change Requests, Landsat Problem Reports and Target Releases

CCR Process

Each CCR must have an initial analysis that contains a rough order of magnitude (ROM) time estimate that is reviewed by the System Prescreening Panel (SPP). The ROM can be +/- 50%. The SPP or assigned engineer may note any potential changes to system or software level requirements. The Systems Engineer will work with the operators and owners of the systems to recommend the CCR to be assigned to a release. Once the initial analysis is approved by the SPP, it is taken to the DCCB for approval from the board. If the DCCB approves the CCR, the CCR will be given a detailed design. During this process the engineer will update any requirements necessary and provide a detailed description for implementation of the problem or enhancement. The detailed design is provided to the system owner (in Level 1 case, the systems engineer) for approval. Once approved, the engineer may begin coding or fixing the problem / enhancement.

Release Testing

Once the development process is completed, the test process begins. The test process consists of 3 independent tests, Unit Test (UT), Integration Test (IT), and System Test (ST). Unit test is the first test and is informally completed by developers. Developers also complete the Integration Test. Instead of simply testing the affected code, the IT attempts to test all associated interfaces and confirm readiness of the system before confirming that all system level requirements are met. IT is used to confirm that all software level requirements are met.

System test is a very formal test. This test must confirm that all system level requirements are met before moving the system to production. System testing may not begin until approval from the DCCB and a formal Test Readiness Review (TRR) is completed. Someone other than a developer should execute the system test, preferably a user or systems engineer. Before the system test may begin, a system test plan is completed and approved by the project team members. Upon completion of the system test, a formal report is provided to the customer and an operational readiness review is completed. The TRR and ORR may not be completed for a small release.

An Operational Validation (OV) period exists for approximately two weeks. During this period operators confirm that the system meets expectations and signs an operational validation document. The OV document is brought to the DCCB for archiving. After OV the release is officially completed and all CCR's associated are cleaned up and archived.

Figure 1 is a simple summarized flow chart of a CCR flowing through the configuration control process.

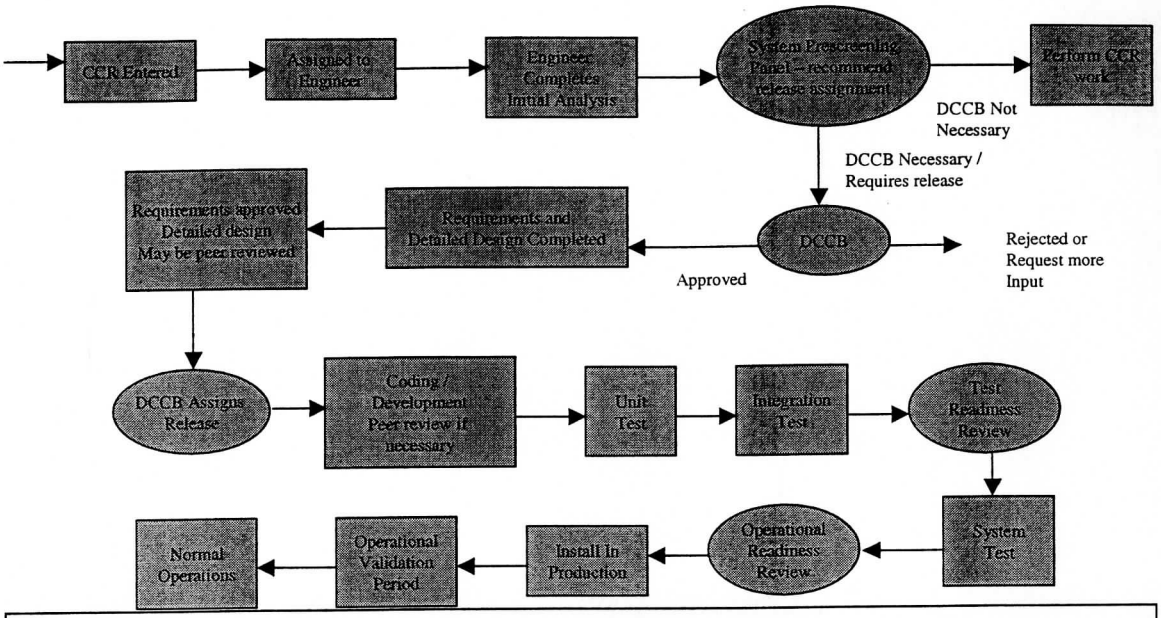

Figure 1 - CCR Data Flow Summary

See Appendix C for a detailed explanation of the testing process.

VI. Landsat 7 Archive and Production Level 1 Team

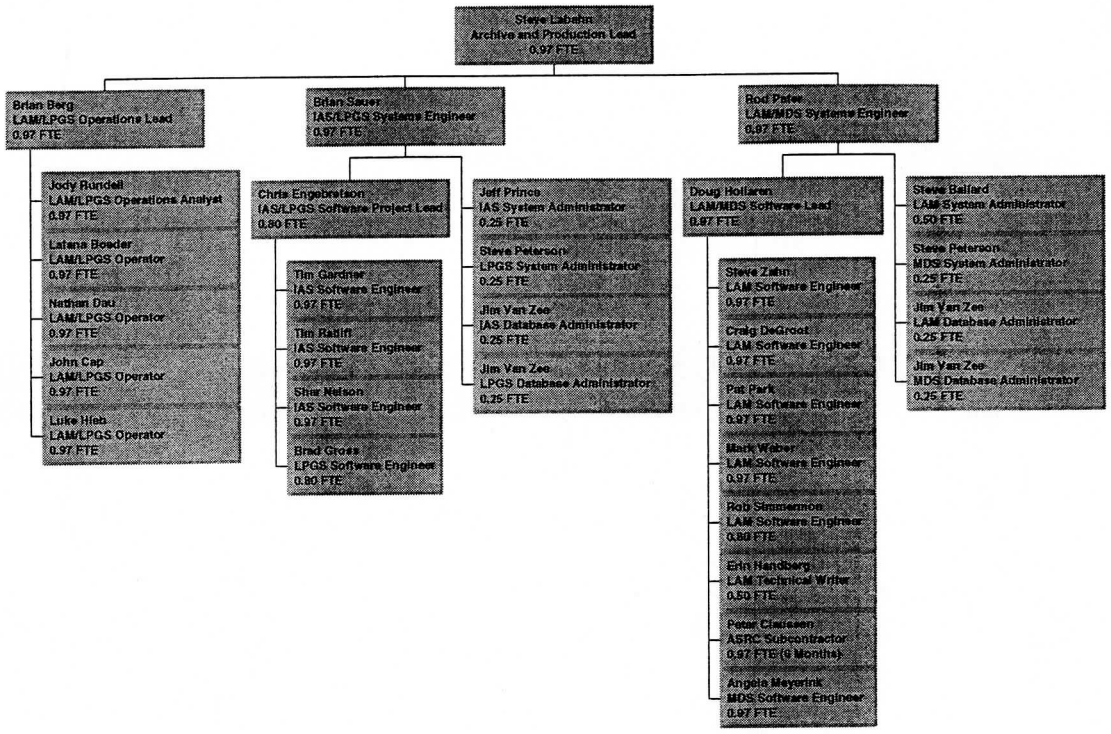

Figure 2 - Archive and Production Organizational Chart

Figure 2 is an organizational chart for the Level 1 team. Each position within the operations and IAS/LPGS area serves a vital role for this project. Since this project is primarily project management, the systems engineering position is described in detail. The systems engineer serves as the release manager and technical project lead. Responsibilities for the systems engineer include (but not limited to):

Release management
Representing the project at the DCCB
Coordinating the systems prescreening panel
Determining system level or business requirements
Product specifications
Requirements management
System testing
Technical trade studies
Systems configuration plans
System deliverables
Technical Assistance
Other duties as assigned

VII. Schedule

Appendix D contains the initial schedule presented at project kickoff. With a project of this type that has lower priority over highly visible items, changes to the schedule are expected. The initial schedule expected all items to be completed by mid-June, 2002.

Since this project inception, Landsat 7 Archive and Processing systems chose to use a consolidated project plan utilizing Microsoft 2000 Project. Individual projects manage their own project schedules. These schedules are migrated into the master project schedule for the Archive and Production Systems. Appendix E is the schedule for the IAS 6.0 release. This release contains the changes for the software consolidation portion. See Table-1 for more information concerning release assignments.

VIII. Project Actions

Hardware Consolidation

One of the first steps for the project is to analyze the existing hardware utilization. Appendix F documents the consolidation plan for the IAS and LPGS systems. Level 1 team members have completed a peer review on the document.

The actual consolidation was completed in December 2001. The effort for the hardware consolidation including document peer reviews is approximately 86 man-hours.

This portion of the project has been very successful in terms of effective use of hardware resources and cost savings. Since the hardware consolidation, engineers have not been strapped for resources. The hardware consolidation project saves the Landsat Program approximately $26,000 for FY 2002 maintenance costs and about $19,000 every year after.

Database Redesign and Consolidation

Database Consolidation

The IAS and LPGS systems utilize many of the same radiometric trending tables. The work order schemas are nearly identical to each other. Yet, the mission of the IAS is much different than the LPGS. The IAS system stores data and predicts data trends much like a data warehouse and data mart. The LPGS system's goal is to produce products for customers to order in a rapid fashion. At any given time, the IAS database may be shutdown for maintenance or other activities.

The LPGS system gathers trending data for all of the scenes that it processes. The IAS system ingests that data on a daily basis and warehouses it. If the LPGS directly used the IAS database to store its trending data, the IAS system's mission would change.

Appendix G is a spreadsheet outlining the object differences between the IAS and LPGS database. Of course, the most obvious difference is the IAS's volume of over 70 GB of warehoused radiometric data.

Appendix H contains the schemas for the IAS and LPGS databases.

Due to the mission, low financial benefit, higher priorities and nature of the systems, program management chose not to consolidate the databases. Future missions such as the Landsat Data Continuity Mission (Landsat 8) may consider this in designs.

Image Assessment System Database Partitioning

The IAS database has been growing dramatically since instrument launch in April of 1999. The IAS database about 70GB in size. All but 318MB of the data reside in the RAD_TREND_DATA tablespace or the RAD_TREND_INDEX tablespace. Based on the existing database, the total amount of data for the 7-year mission, excluding FASC scenes, will be approximately 157.5 GB.

Several tables in the database are unmanageable. If data is lost, recovery may not be possible. Backups for this data must occur daily even if the old data has not changed. One of the tables in the RAD_TREND_DATA tablespace contains more than 200 million rows and is over 20GB in size. Administration of these types of tables is very time consuming and unpractical.

The objective of the IAS Database Partitioning activity of this project is to segment the large trending tables into partitions using Oracle's Partitioning Option. Making changes to these tables is not a trivial task. Large tables may require exporting and importing which can take a day or more per table.

Appendix I contains CCR 1715 used to track the IAS Partitioning portion of the project. This CCR actually holds Appendix J – IAS Partitioning Analysis and Detailed Design, Appendix K – IAS Partitioning System Test Plan, and Appendix L – IAS Partitioning System Test Report. All implementation aspects went as planned except the tables were unable to partition by date range. Not all tables contain a date range. The detailed design recommended creating a date field on the tables without one and populating it but the inserts during population were too time consuming. Tables have been partitioned by Band number, which provided a similar result. By partitioning with band number, an even split of the data has been attained and stored in multiple evenly distributed tablespaces.

The IAS Partitioning System Test Plan is the formal test plan used to approve the IAS System test for production purposes. All test cases identified in the plan have been executed. The IAS System Test Report shows the results of the partitioning project. All test cases were successful.

Most of the benefits from the partitioning portion of the project are difficult to demonstrate in terms of dollars. Many of the benefits will not be recognized unless data

is lost and recovery is necessary. Management of the database has decreased dramatically. Backups of the database are much more efficient. Queries using the partitioned tables may run in $1/8^{th}$ the time. Many of the benefits are intangible but create a professional image to the USGS.

IAS and LPGS Software Consolidation

The IAS and LPGS software consolidation is the most time consuming activity of the consolidation project. It also has the highest risk of changing priority. Once the consolidation of the software archives is started, a release will not be able to be finished until the archive consolidation is completed.

IAS GUI Redesign

Appendix M contains CCR 1698 that outlines the changes necessary for the IAS GUI redesign. In reality, this problem is a GUI conversion instead of a redesign. Since redesigning the GUI could consist of endless changes, MMO management chose to scope the GUI to convert the Operator User Interface from Oracle Designer to Trolltech QT interfaces. All forms will be converted as a "one-to-one conversion. This task is a major effort in itself, yet incorporating many changes. This CCR would encompass most of the IAS 6.0 release.

The requirements for the CCR consisted of listing each form and function from the original interface and assigning it a unique requirement. Appendix N is the IAS software

requirements document for the GUI redesign. It is also attached to CCR 1698. This document was signed before the prototyping process began.

As parts of the GUI are constructed, IAS analysts review sections and provide input for simple enhancements. The sessions are similar to joint application development sessions used in many software development organizations. After the prototype is built and informally approved by the IAS analysts, a detailed design is written for CCR 1698. This detailed design is approved by the DCCB and the CCR is officially assigned to IAS Release 6.0.

As different pieces of the GUI are completed, the lead software engineer and systems engineer updates the IAS 6.0 schedule. The schedule for the IAS 6.0 release will change several times because resources are assigned to higher priority projects. One of the software developers is assigned to the project in early March. Due to a high priority release from another project, the developer is finally available at the end of May. With an extra effort from other developers, the project is only two weeks behind schedule with a production delivery of August 13th, 2002.

Appendix O contains the system test plan and test cases for IAS Release 6.0. Successful execution of this test is the formal acceptance of the release before it moves to production. The test plan consists of test cases and a matrix to all requirements. This will confirm that each requirement is checked. Upon a successful system test report, the system will be moved into production in an operational validation (OV) environment.

The release will be in an OV mode for about two weeks. After the operational validation document is signed by the IAS operations lead, the system will officially be in final production.

Software Library Consolidation

The software library consolidation will take place within the LPGS and IAS 6.0 releases. CCR 1729 is included in appendix P. This CCR includes a detailed analysis and design outlining the work to perform the consolidation.

This project requires coordination of the configuration control group and the software development group. In the past, the configuration control group controlled the IAS archive and the LPGS software development team managed the LPGS archive. Since this activity requires the consolidation of the two archives, both groups must agree to policies for managing the archive.

With a completed consolidation of the archive, the IAS and LPGS will hold the ability to generate individual releases as subsystems. Identifying a specific subsystem release is done with tag assignment. For example, all files for the IAS 6.0 Release will be assigned an IAS 6.0 tag. The LPGS 6.0 release will be assigned a LPGS 6.0 tag. Shared files for the releases will be assigned both the IAS 6.0 and LPGS 6.0 tags.

Operational Business Processes

A meeting was held on October 31st, 2001 to discuss this topic. The meeting notes from this discussion are included in Appendix Q. After discussion with the Archive and Production task manager and operations lead, it is decided to defer all work for this activity at this point.

IAS Automated Delivery

This topic has been discussed in several informal sessions and a meeting taken place on October 31st, 2001. The notes from this meeting are included in appendix Q. IAS analysts spend approximately 30 minutes per day ordering data for their daily ingest. A list of potential data is sent to the analysts from the EDC DAAC. In conclusion, some of the scenes that the IAS analysts order may be ordered in an automated fashion.

After the October 31st meeting, the systems engineer met with systems engineers from the DAAC to determine if an automated interface was available at the DAAC. At this point in time the automated interface is not available. It may be possible for the Level 1 software development team to develop some type of automated interface to ingest the available scenes and parse it. This will only automate approximately one-half of the total automation.

After discussion with MMO management, this task is put on hold.

Public Relations Imagery

It is common for the IAS analysts find data that is unique for public relationship purposes. MMO management chose to let the IAS analysts to continue to perform the task. As a very low priority, the analysts will build a small web server containing about 1 terabyte of public relations data. Only certain members of the EROS Data Center Landsat evaluation team will download this data. This project is managed by the Image Assessment Analysts. The Level 1 Systems Engineer will assist with computing needs for the project. The activity became out of scope of the consolidation project. In May 2002, a 1 terabyte Linux system was procured for the project. The Image Assessment Analysts have hired an Intern to load the system.

IX. Conclusion

Each deliverable of the project has been completed with success. Many of the project's benefits are intangible. Some of the direct benefits of the project include:

Benefit	Description
Financial	The development hardware consolidation project alone saves the program $26,000 in FY02 and about $19,000 every year thereafter. It equates to about $102,000, assuming five more years of Landsat 7 mission.
System Administrative	The software library consolidation merged two software archives into one creating less administration and manual tasks for configuration management personnel and software developers. The hardware consolidation eliminates a system to maintain. This saves systems administration resources. Shortly after the consolidation, the project scaled back systems administration resources by approximately 20%.

	The IAS database partitioning project makes an unmanageable database easily administered. It is now practical to recover any portion of the database at any time.
Scalable and Supportable	Unsupported Oracle Developer 2000 products are now eliminated. New products are now being used that offer greater scalability.
Strategic Architecture	The organization of combining the systems provides strategic advantages to adapt to new platforms. It also provides support for additional platforms such as LINUX.

Table 2 - Summary of Benefits of the Project

Future Considerations

The IAS and LPGS hardware is beyond its life cycle. An architecture trade study must be completed. Software may be ported to another platform. Most platforms can be included in the trade study since the Level 1 tools are easily ported.

Some general scenes ordered by the IAS analysts may be easily obtained by using an XML extraction tool that the DAAC recently released. This tool may provide the ability to query and order selected data in an automated fashion. This tool should be researched.

Appendix R – List of Acronyms

A&P	Archive and Production
CCR	Configuration Change Request
DAAC	Distributed Active Archive Center
DCCB	Data Handling Facility Configuration Control Board
DCPF	Data Capture and Processing Facility
EDC	EROS Data Center
EDC DAAC	EROS Data Center Distributed Active Archive Center
GUI	Graphical User Interface
IAS	Image Assessment System
IT	Integration Test
LPGS	Level 1 Product Generation System
LPR	Landsat Problem Report
LPS	Landsat 7 Processing System
MMO	Mission Management Office
OV	Operational Validation
OVD	Operational Validation Document
SPP	System Prescreening Panel
ST	System Test
UT	Unit Test

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[i] IAS/LPGS Consolidation Project Plan, EROS Data Center, Landsat 7 Program, Archive and Production Systems